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Harris

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[54] **PISTON AND CYLINDER CLAMPING MOTOR**

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[73] Assignee: **Peek Brothers Investments, LLC**, Sedlia, Colo.

[21] Appl. No.: **477,826**

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(Under 37 CFR 1.47)

Related U.S. Application Data

[60] Continuation of Ser. No. 238,454, May 5, 1994, abandoned, which is a division of Ser. No. 4,941, Jan. 15, 1993, abandoned.

[51] **Int. Cl.**[6] **F01B 7/20**

[52] **U.S. Cl.** .... **92/52**; 92/53; 91/167 R; 91/156

[58] **Field of Search** .... 92/51, 52, 53; 91/167 R, 281, 152, 156, 159

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Attorney, Agent, or Firm—Holland & Hart LLC

[57] **ABSTRACT**

A valve spring compressor apparatus for removing and installing valve springs on automotive racing engines includes a valve seat and a compressor pump assembly. The valve seat is placed between the valve spring and the engine housing. The compressor engages the valve spring seat with a support arm and extends a piston toward the valve spring seat, thus compressing the valve spring and allowing for the removal of the retainer ring and keeper lock. The compressor uses a source of compressed air to drive a power piston into a compression chamber multiplying the supply air pressure several times. This multiplied air pressure is retained in the extension piston chamber by a one-way valve. As the extension piston extends, the multiplied air pressure in the extension piston is maintained by repeated cycling of the compressor.

2 Claims, 4 Drawing Sheets

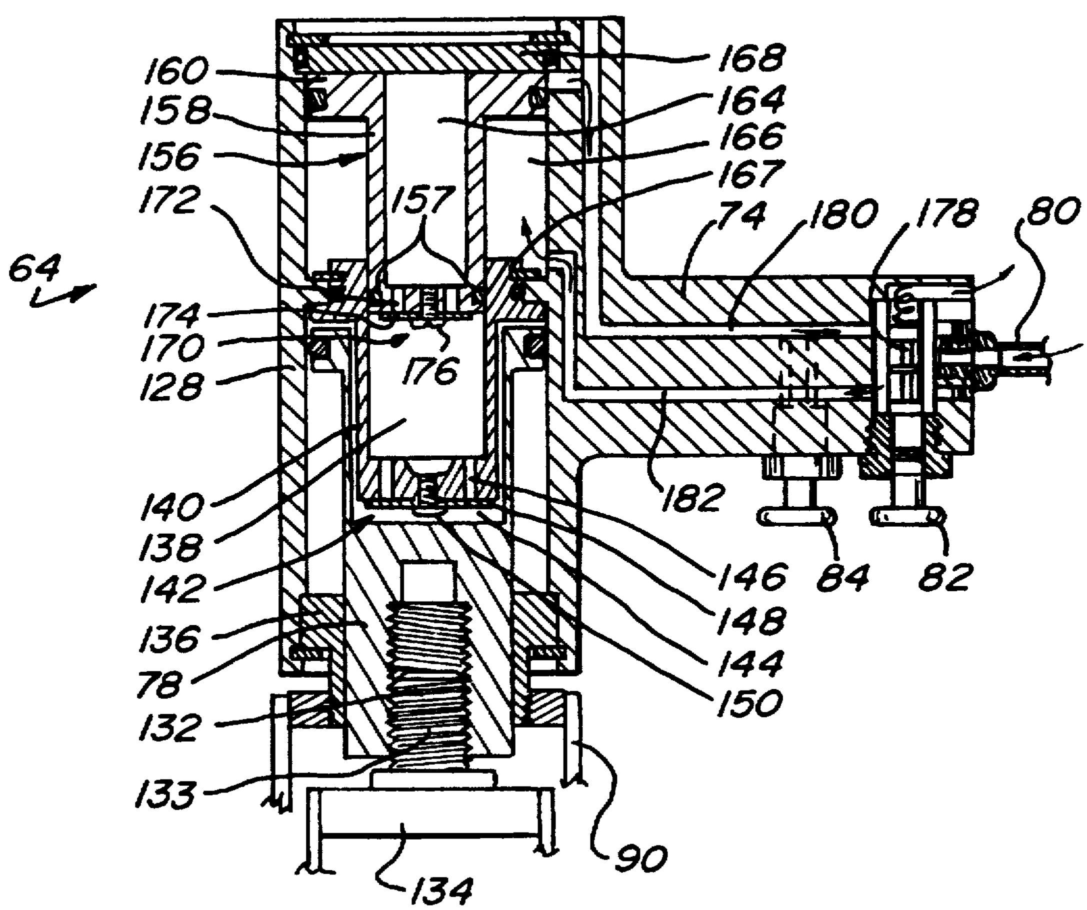
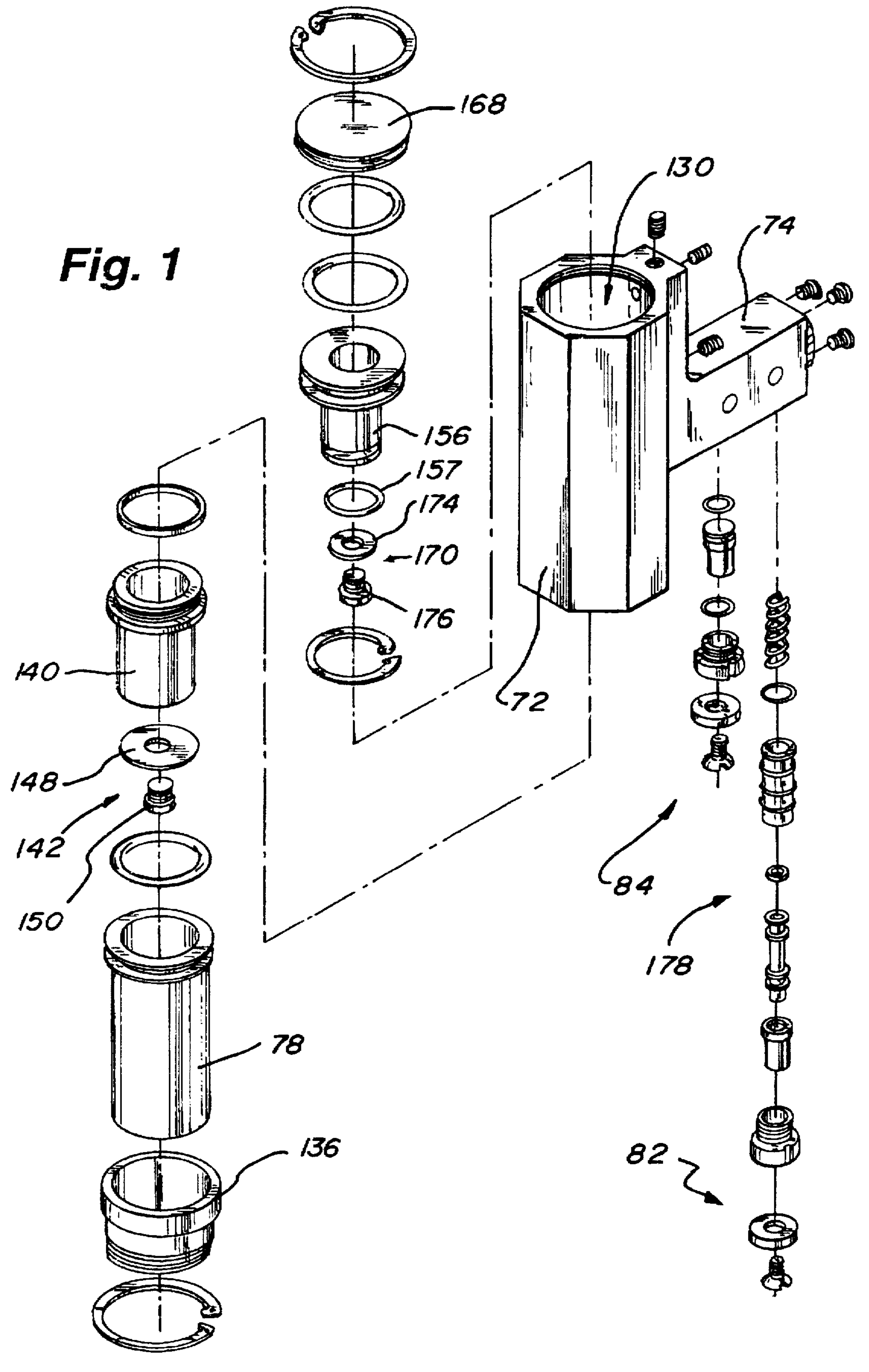


Fig. 1



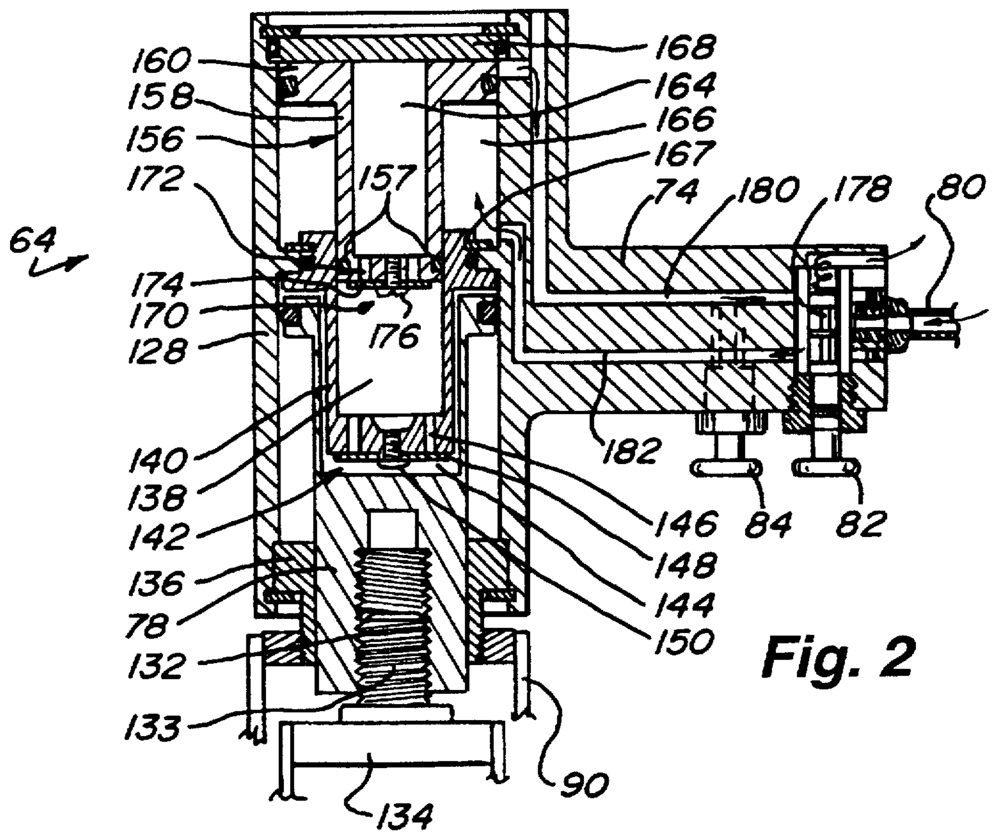

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Fig. 2

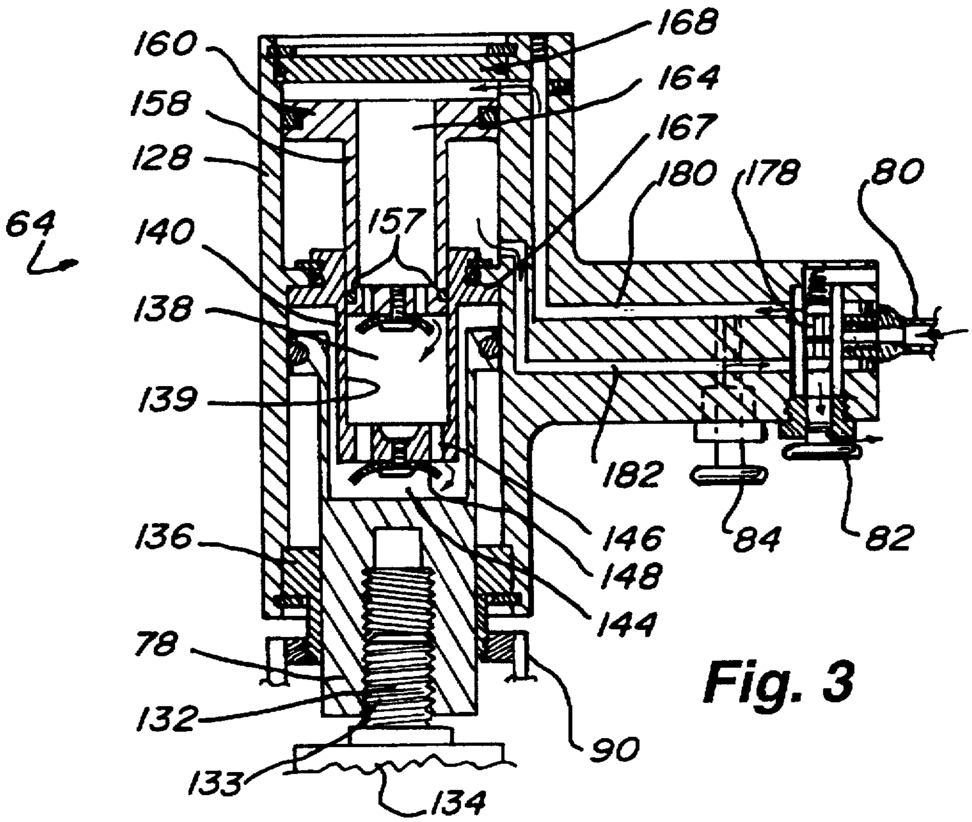
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Fig. 3

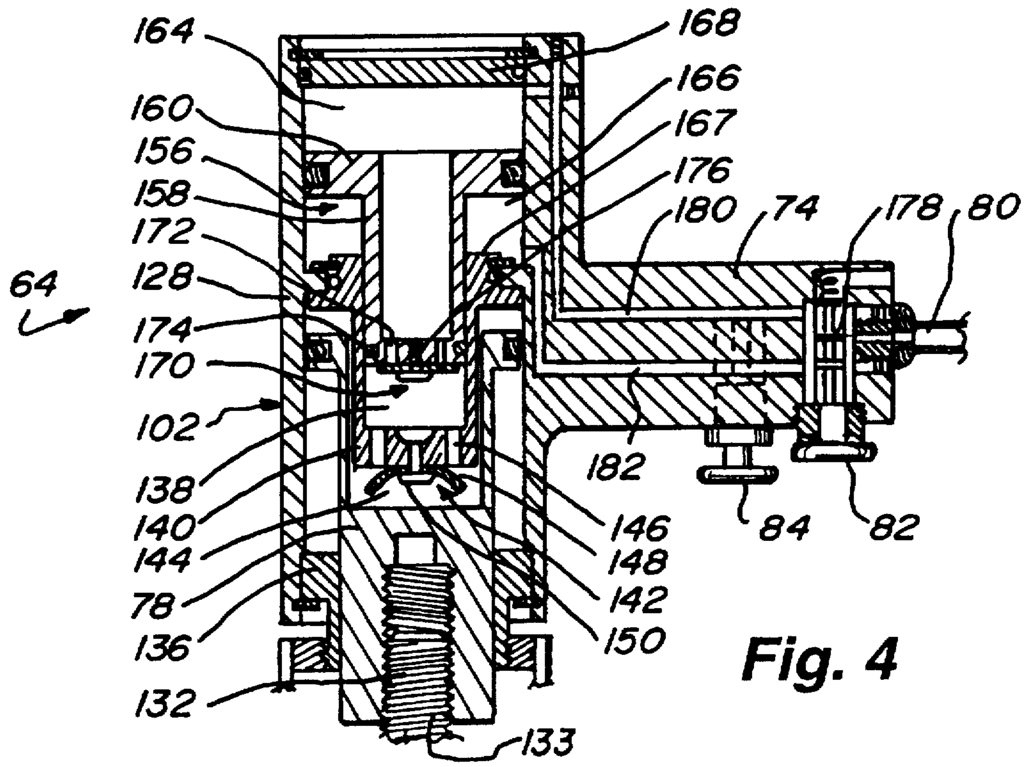
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Fig. 4

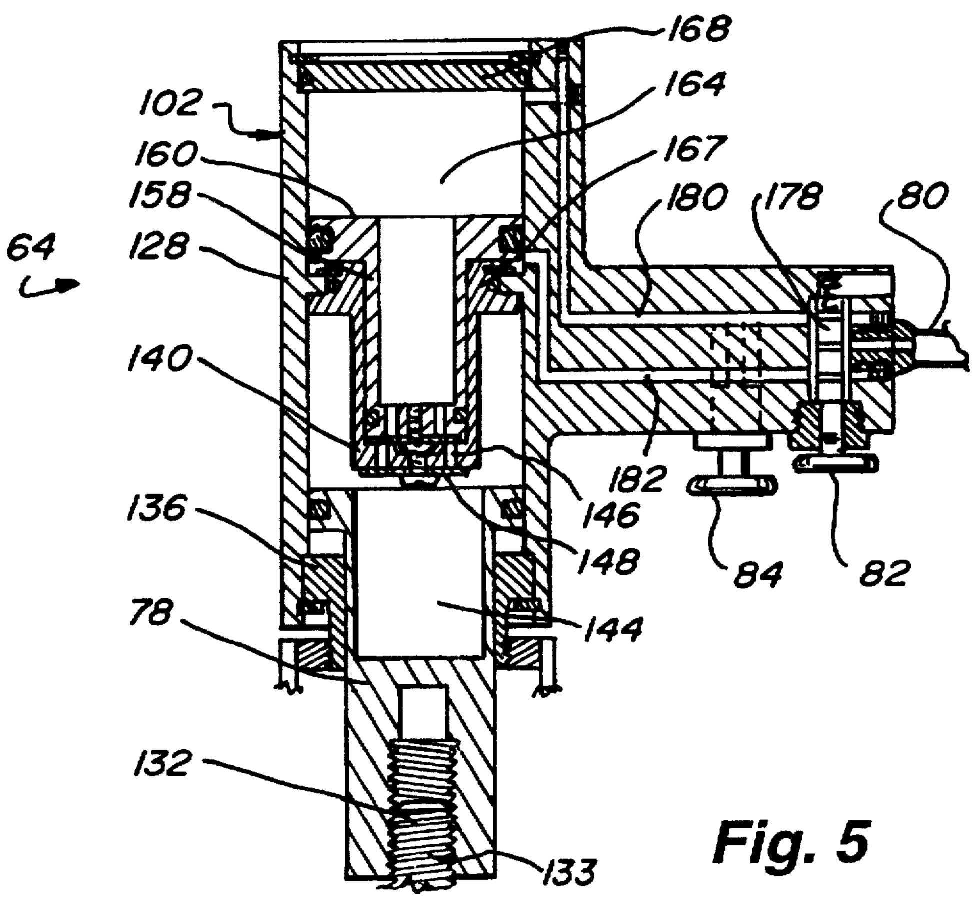
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Fig. 5

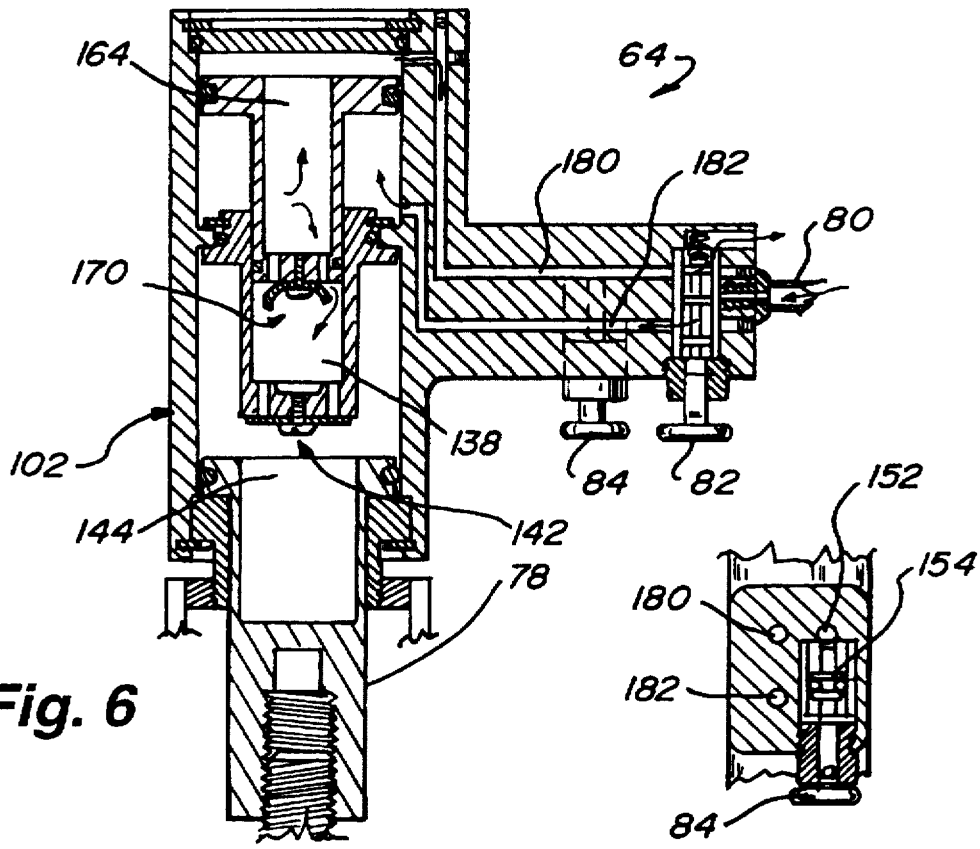

Fig. 6

Fig. 8

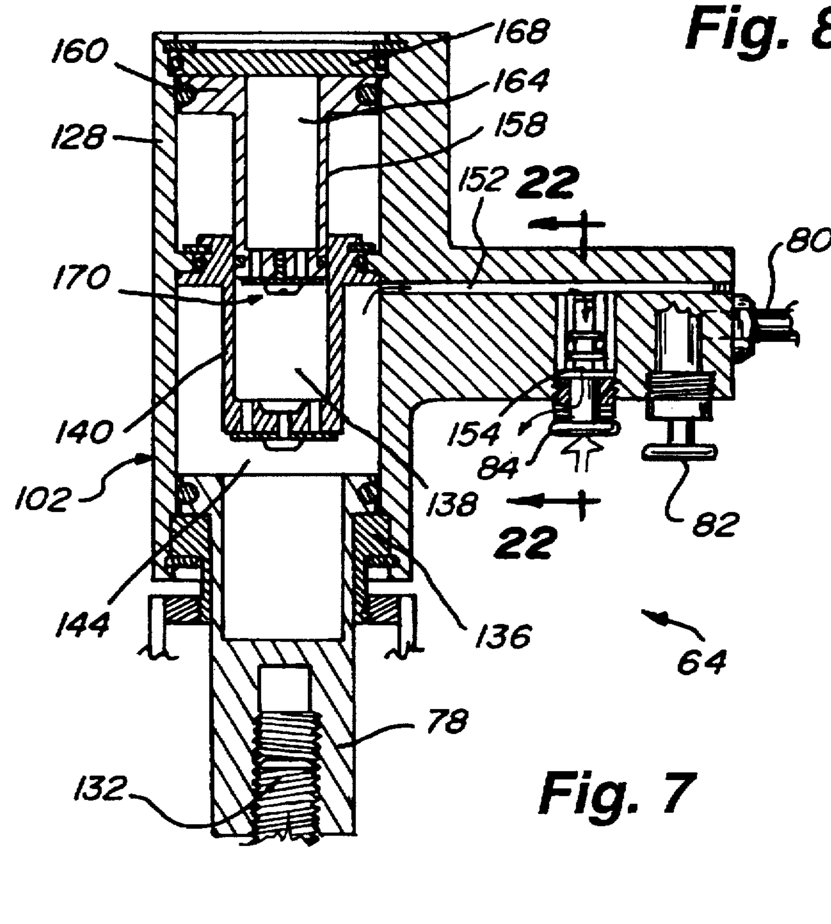

Fig. 7

PISTON AND CYLINDER CLAMPING MOTOR

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of application Ser. No. 08/238,454 filed May 5, 1994, now abandoned, which application is a division of application Ser. No. 08/004,941, filed Jan. 15, 1993, now abandoned.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a pressure fluid actuated piston and cylinder clamping motor finding particular but not exclusive use in a clamping application such as an apparatus for removing or installing the valve spring of an internal combustion engine.

OBJECTS OF THE INVENTION

It is the principal object of this invention to provide an improved pressure fluid actuated piston and cylinder clamping motor.

It is another object of this invention to provide a motor of the foregoing character which is easily and quickly actuated to provide clamping force.

It is still another object of this invention to provide a motor of the foregoing character which can be actuated to increase its working pressure force.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded perspective view of the clamping motor embodying the present invention.

FIG. **2** is a vertical section view of the clamping motor embodying the present invention.

FIG. **3** is a section view similar to FIG. **2** but showing the clamping motor in an initial operating position.

FIG. **4** is a section view similar to FIG. **2** but showing the clamping motor in a first stage compression stroke position.

FIG. **5** is a section view similar to FIG. **2** showing the clamping motor in a first stage compression stroke position but with the clamping piston extended.

FIG. **6** is a section view similar to FIG. **2** but showing the clamping motor in a beginning position for a second stage compression stroke position.

FIG. **7** is a section view similar to FIG. **5** but showing the clamping motor in a pressure force release position.

FIG. **8** is a section view taken substantially in the plane of line **8**—**8** on FIG. **7**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The clamping motor **64** embodying the present invention (FIGS. **1**–**8**) is a hand-held unit comprised of a body **72** and integral handle **74**. The body **72** includes a power piston **78** which extends from the body when the motor is actuated. Located on the handle **74** of the motor **64** is a coupling **80** to which a source of pressure fluid such as pneumatic compressed air supply (not shown) can be attached. Also located on the handle are two, button-actuated, control valves adapted to be pressed by an operator to control the operation of the motor **64**. The first valve, a directional valve **82**, actuates the motor **64**. The second, a bleed valve **84**,

bleeds air pressure from the motor body **72** to release clamping pressure.

The power piston **78** is slidably positioned within an axially extending longitudinal cylinder bore **130** defined in a cylinder housing **128** forming a part of the motor body **72**. The power piston **78** defines an internal threaded bore **132** extending along its longitudinal axis and opening into the outer end thereof to receive and support a threaded bolt **133** of a jaw plate **134**. The power piston **78** slides along the inner surface of a piston guide **136** which is mounted in and attached to the lower end of the cylinder housing **128**. A second jaw **90** is secured to said piston guide and extends below the power piston jaw **134**. The jaws are moved toward each other by the motor **64** to provide a clamping action.

Located within the longitudinal cylinder bore **130** in the motor cylinder housing **128** is a compression chamber housing **140** defining axially therein a bore **139** forming a compression chamber **138**. The compression chamber housing **140** is cylindrical in shape with one closed end and one open end. The closed end defines ports **146** extending therethrough and closed by a check valve **142** which can either allow or prevent fluid communication between the compression chamber **138** and a power piston chamber **144** defined in the cylinder **128** above the power piston **78** and between the compression chamber housing **140** and the power piston **78**. The check valve **142** is a one-way valve comprised of a pliable, mylar check washer or disk **148**. The check valve **142** seals the port openings when the air pressure in the power piston chamber **144** exceeds the air pressure in the compression chamber **138**. The washer **148** is held in place by a screw **150**. When the air pressure in the power piston chamber **144** is less than the air pressure in the compression chamber **138**, the washer **148** is not forced against the compression chamber housing **140**, and air pressure fluid can flow into the power piston chamber **144**.

A compression piston **156** is slidably positioned in the longitudinal cylinder bore **130** of the pump housing **128**, and forms a cylindrical compression piston body **158** which is received in the open end of the compression chamber **138**. An O-ring **157** on the inserted end of the compression piston **156** provides a sliding seal between the piston body **158** and the cylinder bore wall **139**. A flange **160** on the compression piston **156** is slidably and sealably positioned in the cylinder bore **130**. An O-ring **162** located on the radial outer surface of the flange section **160** provides a fluid tight seal between the piston **156** and the cylinder bore **130** to form a piston pressure chamber **164** between the piston **156** and the closed end wall **168** of the cylinder **130**. A return chamber **166** is formed by the volume between the flange **167** of the compression chamber housing **140** and the flange **160** of the compression piston **156**. The compression piston **156** defines an axial bore **168** opening into the piston pressure chamber **164** and closed at the end of the piston. The piston end defines ports or passages **172** therethrough, which ports are closed by a check valve **170**. The compression piston check valve **170** is similar in function and components to the power piston check valve **142** and is formed by a mylar washer **174** secured to the piston end by a screw **176**. When the fluid pressure in the compression chamber **138** exceeds the fluid pressure on the power piston **156**, the compression piston check valve **170** closes, and the power piston check valve **142** opens to allow the fluid pressure on the power piston to increase.

A directional valve **178** is provided to route supply air from the coupling **80** to either the compression piston chamber **164** or the compression piston return chamber **166** through a first passageway **180** or a second passageway **182**, respectively. The directional valve **178** is actuated by pressing the directional valve button **82** toward the handle **74**. When the button **82** is pressed, supply air is provided to the compression piston chamber **164** through the first passageway **180**. Simultaneously, the directional valve **178** vents the compression piston return chamber **166** to the ambient atmosphere through the second passageway **182**. When the button **82** is released, the directional valve reverses and supply air is provided to the compression piston return chamber **166** through the second passageway **182** and the compression piston chamber **164** is vented to the ambient atmosphere through the first passageway **180**.

A third passageway **152** leads from the extension piston chamber **144** through the handle **74** of the motor assembly **64** to a bleed valve **154** (FIGS. **7** and **8**). The bleed valve **154** is actuated by pressing the bleed valve button **84** toward the handle. With the button **84** in this position, there is open fluid communication from the extension piston chamber **144** to the ambient atmosphere through the third passageway **152**. In this manner, actuation of the bleed valve **154** bleeds fluid pressure from the pump assembly **102**.

In operation, a pressurized source of supply (not shown) of pressure fluid, compressed air in the present example, is connected to the coupling **80** and the bleed valve is actuated to normalize the air pressure in the power piston chamber **144** so that the power piston is in a retracted state. The supply air pressure in the power piston return chamber **166** will drive the compression piston **156** against the back wall **168**.

To begin a clamping operation, the directional valve **178** is actuated to direct compressed air to the compression piston chamber **164**. The compression piston return chamber **166** is simultaneously vented to the atmosphere (FIG. **6**). The force exerted against the compression piston **156** by the compressed air pressure in the compression piston camber **164** exceeds the force exerted against the compression piston flange **160** in the compression piston return chamber **166** and drive the compression piston longitudinally into the compression chamber **138** to compress the air therein. Both the compression piston check valve **170** and the extension piston check valve **142** open to supply compressed air from the compression chamber **138** to the power piston chamber **144** as well as the compression chamber **138**. This pressure increase in the extension piston chamber **144** drives power piston **78** outwardly until it meets a clamping surface with a force which is equal to the supply air pressure multiplied by the surface area of the power piston exposed to the compressed air.

When movement of the power piston **78** stops as the clamp jaw **134** engages the surface being clamped, air pressure in the power piston chamber **144** and compression chamber **138** increases to greater than the air pressure in the expanding compression piston chamber **164** and the compression piston check valve **170** closes. The surface area of the compression piston **156** in the compression chamber **138**, which area is normal to the direction of movement of the piston, is smaller than the surface area of the compression piston **156** in the compression piston chamber **164**, normal to the direction of movement of the piston. Preferably, the normal surface area in the power piston chamber **164** is 4.5 times greater than the normal surface area in the compression chamber **138**. Therefore, the power piston will be forced into the compression chamber **138** until the air pressure in the compression chamber **138** and power piston chamber **144** is 4.5 times greater than the supply air pressure, or until the compression piston **156** abuts the closed end of the compression chamber **138**, whichever comes first. As a result, the power piston **78** exerts a greater force against the application surface. At this point, the extension piston check valve **142** closes, trapping the multiplied air pressure in the power piston chamber. The first pressure multiplication cycle is now complete.

To further increase the power piston force, the operator releases the button of the directional valve **82** whereupon the valve shifts to vent the supply air from the compression piston chamber **164** and provide supply air to the compression piston return chamber **166**. This causes the compression piston to be returned to its initial position adjacent the back wall **168**. As the compression piston **156** retracts from the compression chamber **138**, the volume of the compression chamber **138** expands and compressed air flows into the chamber **138** through the piston check valve **170** forced out of the compression piston chamber **164**.

When the operator again shifts the directional valve **82**, the supply air drives the compression piston **156** into the compression chamber **138** as before, further compressing the air, and multiplying the air pressure therein. The piston check valve **170** remains closed, resulting in a pressure multiplication of 4.5. When the fluid or air pressure in the compression chamber exceeds the pressure in the power piston chamber **144**, the compressed air flows into the chamber **144** through the piston check valve **142**. In this way a multiplied pressure force is developed in the power piston chamber **144**. Repeated cycling through pressure multiplication cycles increases the output force of the motor.

As can be appreciated, the present invention provides the capability of easily increasing an applied force. It can be seen that with a pressure multiplication factor of 4.5, and with a supply air pressure of one hundred pounds per square inch (PSI), the pressure in the power piston chamber will be 450 PSI. Because the diameter of the power piston is 2.25 inches, the normal surface area is 3.97 square inches. Thus, the power piston is capable of exerting a clamping force of 3.97 square inches times 450 PSI or over 1785 pounds. Even when a low-end compressed air source having only 60 PSI is used, a clamping force of over 1070 pounds can be achieved.

While certain illustrative embodiments of the present invention have been shown in the drawings and described in detail in the specification, it should be understood that there is no intention to limit the invention to the specific form and embodiments disclosed. On the contrary, the intention is to cover all modifications, alternative constructions, equivalents and uses falling within the spirit and scope of the invention as expressed in the appended claims.

It is claimed:

1. A piston and cylinder fluid pressure clamping motor activated by pressure fluid from a pressure fluid source and comprising, in combination, a tubular housing defining a cylinder extending axially therethrough, a plate at one end of said housing sealingly closing said cylinder, an annular piston guide mounted in said cylinder at the other end of said housing, a power piston slidably mounted in said guide and having one end extending axially outwardly of said housing, the opposite end of said piston having a flange thereon, a seal on said flange slidingly and sealingly engaging the wall of said cylinder, a tubular second stage housing sealingly fixed within said cylinder and defining a second stage cylinder, said second stage cylinder having a closed end adjacent said piston and an open end opposite thereto, said closed end defining a pressure fluid flow passage therethrough, a check valve operatively closing said passage for precluding the flow of return pressure fluid therethrough, a floating compression piston slidably mounted in said cylinder and said

second stage cylinder, a flange on one end of said compression piston slidably and sealingly engaged with said cylinder, a seal on the other end of said compression piston slidably and sealingly engaging said second stage cylinder, a pressure fluid passage extending axially through said compression piston, a check valve on the end of said piston inserted into said second stage cylinder for precluding return pressure fluid flow therethrough, an arm on said housing extending laterally therefrom and connected to said pressure fluid source, said arm defining a pressure fluid passage for directing pressure fluid from said source to said cylinder adjacent said end plate and said compression piston for applying fluid pressure to said compression piston in a direction away from said plate, said arm further defining a pressure fluid passage for directing pressure fluid from said source to said cylinder between said compression piston and said fixed second stage housing for applying pressure fluid to said compression piston in a direction toward said cylinder cap, a control valve on said arm for selectively controlling the flow of pressure fluid to said pressure fluid passages to increase the fluid pressure on said power piston, a pressure fluid exhaust passage opening into said cylinder between said power piston flange and said second stage cylinder housing for exhausting pressure fluid therefrom, and an exhaust valve on said arm for controlling the exhaust of pressure fluid from said exhaust passage and thereby the release of the fluid pressure on said power piston.

2. A piston and cylinder fluid pressure clamping motor activated by pressure fluid from a pressure fluid source and comprising, in combination, a tubular housing defining a cylinder extending axially therethrough and opening into one end of said housing, the other end of said housing being closed, a power piston slidably mounted in said cylinder and having one end extending axially outwardly of said housing, a seal on the opposite end of said piston slidingly and sealingly engaging the wall of said cylinder, a tubular second stage housing sealingly fixed within said cylinder and defining a second stage cylinder, said second stage cylinder having a closed end adjacent said piston and an open end opposite thereto, said closed end defining a pressure fluid flow passage therethrough, a check valve operatively closing said passage for precluding the flow of return pressure fluid therethrough, a floating compression piston slidably mounted in said cylinder and said second stage cylinder, a flange on one end of said compression piston slidably and sealingly engaged with said cylinder, a seal on the other end of said compression piston slidably and sealingly engaging said second stage cylinder, a pressure fluid passage extending axially through said compression piston, a check valve on the end of said compression piston inserted into said second stage cylinder for precluding return pressure fluid flow therethrough, a pressure fluid conduit for directing pressure fluid from said source to said cylinder adjacent the closed end of said housing and said compression piston, a pressure fluid conduit for directing pressure fluid from said source to said cylinder between said compression piston and said fixed second stage housing for applying pressure fluid to said compression piston in a direction toward said closed housing end, a control valve for selectively controlling the flow of pressure fluid to said pressure fluid passages to increase the fluid pressure on said power piston, a pressure fluid exhaust passage opening into said cylinder between said power piston and said second stage housing for exhausting pressure fluid therefrom, and an exhaust valve for controlling the exhaust of pressure fluid from said exhaust passage and thereby the release of the fluid pressure on said power piston.

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